



## REVIEW OF THE EASTPORT MARINE PROTECTED AREA MONITORING INDICATORS, PROTOCOLS AND STRATEGIES



Image: American Lobster



Figure 1. Map of Round Island and Duck Islands Marine Protected Areas and the Eastport Lobster Management Area, Eastport Peninsula, Newfoundland and Labrador

### Context:

In support of the Health of the Oceans Initiative (component 21), Science sector is required to deliver indicators, protocols and strategies for monitoring the individual conservation objectives for established Marine Protected Areas (MPAs).

Monitoring of biological and ecological indicators (and their respective threats) is applicable to: 1) incorporation into broader MPA monitoring "plans" or "programs" (addressed by the DFO Oceans Sector); 2) tracking status, condition and trends to determine if MPAs are effective in achieving their Conservation Objectives; 3) aiding managers in the review of MPA management plans to achieve conservation objectives; and 4) reporting to Parliament and Canadians (ultimately, via the management sector). Therefore, the selection of indicators and protocols for collection and analysis of data must be scientifically defensible.

Although not officially designated as an MPA until 2005, Science in support of the Eastport initiative has been ongoing since 1997. Therefore, the review of monitoring indicators, protocols and strategies for the Eastport MPA requires taking into consideration the indicators that have been used to date, advising on their suitability for measuring against the existing conservation objectives for the Eastport MPA, identifying other potentially important indicators where required, and if appropriate, assessing trends in

*the available indicator data to assess the status of the Eastport lobster population.*

*This Science Advisory Report is from the January 27, 2011 meeting on Eastport Bay Marine Protected Area (MPA) Monitoring Indicators, Protocols and Strategies. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.*

## SUMMARY

- The indicators currently being used to monitor the Eastport MPA lobster population are appropriate to assess this population. However, monitoring reproductive potential, specifically as a proxy of recruitment, requires further analysis of the existing data.
- The monitoring activities currently being carried out to monitor the Eastport lobster population, i.e., the indicators, protocols, and strategies, are appropriate to provide information for many of the indicators required to monitor the Eastport MPA against its conservation objective(s). However, enhanced protocols and/ or further analysis of the data available are recommended.
- Fall research sampling and tagging (inside and adjacent to the MPAs) provides information on comparative population structure. Tagging can also provide information on population density inside the MPAs and the movement behaviours of lobsters. Outside the MPAs (i.e., the EPLMA), commercial logbook data provides an index of fishery performance (Commercial Catch per Unit Effort (CPUE)), and may be useful for the estimation of population size, while at-sea-sampling during the commercial season provides additional information including population structure (e.g. average size; sex ratio).
- Recommendations for enhancing future monitoring protocols include: establishment of additional comparison sites (based on habitat characteristics if available); incorporation of additional traps with small and large entrance rings during sampling events (addressing catchability of very small and very large lobsters); and improvement of location data during fall research sampling.
- Recommendations for enhancing the analysis of existing data provided by current monitoring protocols includes consideration of: estimation of reproductive potential (e.g. egg production/fecundity) inside the MPAs versus adjacent areas; further analysis of tagging data (e.g., movement by size groups); presentation of berried females by trap hauled and/or by group size category (i.e., at the same scale); and calculation of abundance and density estimates from fall sampling (inside and adjacent to the MPAs).
- An evaluation of existing data from commercial at-sea sampling indicates stable CPUE and an increase in the average size of female lobsters outside of the MPAs. Data from research sampling indicates the average size of both females and males inside MPAs has also increased over time.
- Analysis of lobster size could be improved by considering only harvestable animals to address the problem of over-represented individuals (small; v-notch; and ovigerous) encountered during commercial at-sea-sampling.
- In order to understand prevailing oceanographic conditions and to develop effective protocols for the study of larval drift, further research is required. Research may also be beneficial to examine the potential effects of v-notching on monitoring results (e.g. male/female size and sex ratio); potential effects of partial (v-notch and berried) and full

protection (MPA) on reproductive success); and carrying capacity and density dependence of lobster populations in the MPAs.

- Enhancing the use of tagging to indicate movements of lobster between the MPA and adjacent areas would prove useful to further understanding movements of Eastport MPA lobsters. Differential movement of lobsters by sex, size group, and depth could also be taken into consideration during the analysis of tagging data.
- If taking into consideration that the original intent (conservation objective) of the MPAs was to produce a viable (=fishable) lobster population in the EPLMA (as opposed to only immediately adjacent to the MPAs), an appropriate target area for monitoring would include the entire EPLMA.

## BACKGROUND

### Establishment of the Eastport MPA

The Eastport Peninsula is located in Bonavista Bay on the east coast of Newfoundland. There are seven core communities on the peninsula and people there have relied heavily on fishing for many generations. Although fishing activity has declined in recent years, it is still vitally important to the Eastport Peninsula, particularly the lobster fishery. In 1997, a decline in local lobster landings, fear of encroachment from outside communities on traditional lobster fishing areas and poaching around the Eastport Peninsula led to self-policing and the implementation of conservation initiatives such as the establishment of a 400km<sup>2</sup> Eastport Peninsula Lobster Management Area (EPLMA), as well as the closure of Round and Duck Islands (2.1 km<sup>2</sup>).

Biologically, lobsters are long-lived, bottom-dwelling invertebrates in which female maturation does not occur until approximately 8-10 years of growth. However, egg production increases exponentially with increasing size, and it is believed that the presence of large lobsters can increase the egg production in an area, thus enhancing the potential of the area as a breeding ground.

Management initiatives undertaken within the EPLMA boundary to conserve the local lobster population included voluntary v-notching (applying a v-shaped notch in the tail of ovigerous females), and reductions in the total number of traps and days fished. Voluntary v-notching is the process of cutting a shallow notch in the tail of an egg-bearing female. V-notched lobsters caught during the commercial fishery are released, thereby protecting known spawners for several years. A v-notch persists for up to two molts (Rowe 2000). The purchase, sale or possession of a v-notched lobster is illegal in Newfoundland and Labrador.

Only fishers from the seven Eastport Peninsula communities are permitted to fish within the EPLMA boundary and no fishing is permitted within the Round and Duck Islands MPAs. Official Oceans Act designation of the Eastport MPA in 2005 provided regulatory prohibition of most activities inside the Round Island and Duck Islands MPAs with the exception of scientific monitoring and research.

The Eastport Marine Protected Area Management Plan, outlining conservation objectives and management actions for the MPA with respect to scientific monitoring, compliance and enforcement, as well as public awareness with the intent to guide and inform management decisions was released in 2007. This Management Plan is scheduled for review and renewal in 2011.

## Conservation Objectives for the Eastport MPA

MPA regulatory conservation objectives are part of site specific regulations published in the Canada Gazette. The monitoring program supporting these objectives is aimed at determining the success of the MPA in meeting the conservation objectives.

The primary regulatory based conservation objective for the Eastport MPA is ***to maintain a viable population of American lobster through the conservation, protection, and sustainable use of resources and habitats.***

## Eastport MPA Monitoring

Commercial logbook data on the Eastport lobster population has been collected each year since 1997, and commercial at-sea sampling has been ongoing since 1998. In addition, fall research sampling/tagging in and adjacent to the MPAs commenced in 1997 and has been conducted annually with the exception of 2003. This existing research and monitoring program has been used to indicate whether the regulatory conservation objectives for the MPAs are being met through the provision of scientific data and information. This review addresses the available Eastport lobster indicator data from 1997 up to 2010.

## Key threats to Eastport MPA Conservation Objectives

In 1997, concentrated fishing efforts and poaching of lobster in Eastport prompted community support to protect the local lobster population from overfishing. Since the establishment of the EPLMA in that same year, and the subsequent establishment of the Eastport MPAs in 2005, lobster populations have been largely sustained. However, an unknown number of lobsters, particularly larger individuals, can migrate from within the MPAs to occupy areas outside the MPA boundaries. Other potential threats to a sustainable lobster population in the Eastport area could be attributed to environmental (e.g., oceanographic temperature and circulation) and trophic conditions (e.g., predator and prey relationships and population structure imbalances).

## ANALYSIS

### Monitoring Indicators

#### Current State of Monitoring Activities

Although two areas in Eastport, Round Island and Duck Islands, have been designated as MPAs under the Oceans Act since 2005, characteristics of lobster populations in that area have been studied since 1997.

Based on the biological/ecological Regulatory Conservation Objective (CO) of the Eastport MPA ***to maintain a viable population of American lobster through the conservation, protection, and sustainable use of resources and habitats,*** two indicators of population change and viability have been monitored to date:

- Commercial Catch per Unit Effort (CPUE)
- Population structure (inside and outside the MPAs)

Supplementary monitoring to these indicators includes the use of tags to track movement of lobsters for the examination of possible spillover effects from the MPAs to commercially harvested areas. Conducted at Eastport since 1997, tagging was incorporated as part of the MPA monitoring program in 2004.

**Selection of Appropriate and Meaningful Indicators as Related to Conservation Objectives:***Commercial Catch per Unit Effort (CPUE)*

Commercial catch per unit effort (CPUE) can be used as an index of fishery performance and as well as (relative) lobster abundance in commercially fished areas adjacent to the MPAs.

*Population structure (inside and outside the MPAs)*

Population structure indicator includes a consideration of average size, size structure and sex ratios inside and adjacent to the MPAs.

Size frequency distributions from this data can show changes to the population structure over time – including specific size changes within various cohorts (e.g., small and large lobsters of either sex).

This fishery independent and comparative research monitoring allows for the effect of constant variables across the MPAs and adjacent areas, such as environmental conditions, to be accounted for in observed changes to the population.

*Movement of lobster*

This information can be used to observe the movement behaviour of various cohorts of lobsters within a population or area. For example, lobster movements may be attributable to such factors as local habitat preferences or increased density in protected areas lending to a 'spill-over effect'.

## Monitoring Protocols

Several weeks of sampling are required during summer and autumn annually to monitor the appropriate indicators for the Eastport MPA.

Summer sampling takes place outside of the MPAs only and coincides with the timing of the commercial lobster fishing season (approximately 2-3 months in duration). This involves lobster harvesters gathering information via logbooks (mandatory and voluntary fields) and at-sea-sampling.

Autumn research sampling takes place both inside and outside of the MPAs and is conducted during a time after which the majority of lobsters have molted in order to reduce tag loss and tagging-induced mortality (when tagging is carried out in conjunction with the event).

In both sampling events, lobsters are caught using commercial wooden traps. These traps allow lobsters to enter through rings between five inches and six inches in diameter, where a space is left between the bottom two laths so that small lobsters (< 65 mm) that are captured can escape. It should be noted, however, that sublegal and very large lobsters are not specifically targeted in this type of trap, resulting in comparisons of population metrics able to be made within a given size class but not among size classes unless selectivity can be quantified.

*Commercial Catch per Unit Effort (CPUE)**Commercial Catch Data*

Commercial Catch per Unit Effort (CPUE) can be obtained via voluntary (1997-2009) and mandatory (2010-) logbook data collected during the commercial lobster fishing season. The determination of CPUE is applicable only to areas outside of the MPAs, as commercial fishing is restricted within the MPAs.

Logbooks, filled out at the end of each fishing day, should contain information on the number of traps hauled, number of legal size lobsters caught, number of undersize males and females, number of commercial berried females, and number of lobster V-notched by the harvester.

This logbook data can be used to calculate CPUE, providing a measure of (relative) abundance of commercial-sized lobster in the Eastport area. The provision of confidence intervals around catch rates may improve the reliability of this indicator.

The analysis of lobster size could be improved here by considering only harvestable animals to address the problem of over-represented individuals (small; v-notch; and ovigerous) encountered during commercial at-sea-sampling.

### **Population structure (inside and outside the MPAs)**

#### *Commercial at-sea sampling*

Data to monitor population structure outside of the MPAs can be collected throughout the EPLMA via at-sea sampling during the summer commercial fishing season. This protocol involves sampling every third commercial trap and recording information on carapace length (with Vernier calipers), sex, and condition (berried and/or v-notched) of all individuals in the trap.

Following the collection of information from sampled traps, regular actions surrounding v-notching (voluntary v-notching of egg-bearing females; and the release of previously v-notched lobsters) and release of undersized individuals still applies.

Commercial at-sea-sampling essentially provides the required data to determine population structure during the commercial season. However, it should be noted that in the above protocol undersized and protected female portions of the population can be inflated in number due to the likelihood for them to be recaptured.

#### *Research sampling*

Data to monitor population structure inside the Round Island and Duck Islands MPAs as well as in the adjacent commercial fishing areas can be collected via autumn (September/October) research sampling.

This protocol involves setting traditional wooden traps (25 inside and 25 outside each of Round and Duck Islands MPAs – for a total of 100 traps) to be sampled every day (weather permitting) for approximately 3 weeks. All lobsters inside the traps are measured using Vernier calipers and data on carapace length, zone of capture, sex and condition (ovigerous and/or v-notched) is recorded.

It is recommended that experimental traps be incorporated into the exiting research sampling protocol to target small lobsters (under 70 mm) and very large lobsters (over 125 mm). This will provide additional information related to population structure – including the co-occurrence/proximity of very large and pre-commercial sized lobsters; and to assist in determining the fecundity of very large female lobsters in presence/ absence of very large males.

The analysis of lobster size could be improved by considering only harvestable animals to address the problem of over-represented individuals (small; v-notch; and ovigerous) encountered during commercial at-sea-sampling.

It is also recommended that additional reference sites, based on habitat similar characteristics, be incorporated to the existing research sampling protocol to broaden the control area being monitored (i.e., add research sampling sites further away from the MPAs as opposed to immediately adjacent to them).

### Tagging

Supplementary information on lobster movement can be obtained via tagging activities. Enhancing the use of tagging to indicate movements of lobster between the MPA and adjacent areas would prove useful to further understanding movements of Eastport MPA lobsters.

Tagging is undertaken during research sampling. Each lobster is marked with a streamer-tag containing a unique number, and new data is recorded on lobsters that have retained their tags from earlier tagging events. Key information recorded during tagging includes trap number, tag numbers, and area caught or recaptured.

Areas are currently subdivided into smaller sections and assigned unique location numbers to track movement. However, incorporation of GPS coordinates to more accurately identify location of tagged lobsters would improve this protocol.

Differential movement of lobsters by sex, size group, and depth could also be taken into consideration during the analysis of tagging data.

As tag return numbers are currently low, incentives for streamer tag returns are imperative to obtaining important information through reporting.

### Strategies for Monitoring

Monitoring the Eastport MPAs lobster population has the potential to include the collection of indicator data/information by non-DFO staff and communities. DFO currently has ongoing external collaborations with lobster harvesters, community partners, and Memorial University of Newfoundland (MUN) in support of monitoring the Eastport MPA. The Eastport MPA has served as a living laboratory in this capacity. Over the last several years, individuals from DFO and MUN have provided valuable hands on training to local stakeholders carrying out the various components of the monitoring program. Through the support of DFO, local individuals have then provided personal and equipment to conduct the MPA monitoring.

While the current strategy has been successful to date, it is important that length and intensity of training of individuals collecting the data always be such that it ensures a reasonable level of data quality assurance in the monitoring program. Potential problems which could interfere with this strategy include changes in long term consistent funding and potential changes in personnel. Additionally, where monitoring programs rely on the voluntary return of tagging information, it should be noted that education and awareness, as well as worthwhile incentives, are key to obtaining data from these tags.

### Analysis of Eastport MPA Indicator data

An evaluation of existing data from commercial at-sea sampling indicates stable CPUE and an increase in the average size of female lobsters outside of the MPAs. Data from research sampling supports the increase in size outside the MPAs, and indicates that the average size of both females and males inside the MPAs has also increased over time.

Changes to the lobster population since the closure of the Round and Duck Islands sites include not only a higher relative abundance of large lobsters, including ovigerous females; but also a broadening of population size structure and increases in average sizes of male and female lobsters; and an increased presence of large lobster in the adjacent fished areas.

## Sources of Uncertainty

The length of time required for the population in the EPLMA to demonstrate a significant response to the closures (stable population) may have taken up to 7 years (1997-2004). Lobsters in the area are estimated to take at least 8 years to attain fishable size. Therefore, the results of the closures could take as long as 15 years to be seen in the larger population of the EPLMA, with indicators of success not being evident before 2012.

Within the EPLMA boundary (areas adjacent to the MPAs) several other conservation management initiatives have also been undertaken, including voluntary v-notching (applying a v-shaped notch in tail of known reproductive females), and reductions in traps and days fished (Davis et al. 2007; Collins and Lien 2002). It should also be noted that an increase in minimum legal size (MLS) for lobsters, from 81.0 mm to 82.5mm, was enacted in 1998. As such, these other conservation efforts may confound the effects of the MPA designation through allowing for additional protection of females specifically, and decreasing overall removal effort in the area.

## CONCLUSIONS AND ADVICE

The monitoring activities currently being carried out to monitor the Eastport lobster population, i.e, the indicators, protocols, and strategies, are appropriate to provide information for many of the indicators required to monitor the Eastport MPA against its conservation objective(s). However, enhanced protocols and/ or further analysis of the data available are recommended.

### Monitoring Indicators

The current indicators: 1) commercial catch per unit effort (CPUE); and 2) population structure (inside and outside the MPAs); as well as monitoring of movement, are either directly or indirectly linked to measuring the effectiveness of the Eastport MPAs in meeting their conservation objective(s).

Tagging and tracking the movement of lobsters is considered supplementary to the information required to monitor the effectiveness of the MPAs. However, continuation of this activity will remain useful to future indication of small scale habitat preferences of lobsters and/or potential spillover effects of the Eastport MPAs.

Implementation of additional indicators, such as fecundity, may also assist in determining if the MPA is successful in meeting its conservation objective of maintaining a viable population of American lobster.

### Monitoring Protocols

Recommended enhancements to monitoring protocols related to data collection include:

- addition of traps targeting small and large lobsters during the fall research sampling
- inclusion of reference sites based on habitat characteristics in fall research sampling
- improved tracking of location (map) during fall research and at-sea sampling sites

Recommended enhancements to monitoring protocols related to data analysis include:

- estimate total egg production/reproductive potential/fecundity inside the MPA versus outside as an indicator of recruitment (fall tagging)
- estimate lobster abundance and density
- conduct further analysis of tagging data (e.g., movement by size groups)

- graph data using the actual numbers not percentages
- compare Eastport at-sea sampling sites to FFAW at-sea sampling sites
- clarify the appropriate area for monitoring and analysis: MPAs/adjacent area/EPLMA

## Monitoring Strategies

As a strategy, continued collection of indicator data/information by non-DFO staff and communities is invaluable to assuring available resources for obtaining the required monitoring information from the Eastport MPAs. At the same time, collaborative efforts with communities, stakeholders and academia benefits education and awareness, stewardship, and research goals. However, it is noted that length and intensity of training should always be such that it ensures a reasonable level of data quality assurance in the monitoring program.

## OTHER CONSIDERATIONS

Some local stakeholders are of the perspective that the entire EPLMA was initially the target of potential positive effects of the closure areas (MPAs). However, under the pretense of providing scientific advice specifically to MPA monitoring, the results of monitoring indicators, protocols and strategies provided herewithin are therefore focused on those required to monitor the effectiveness of the MPAs on lobster conservation within.

Lobster fishers in the Eastport area are also concerned that the MPA may be of greater benefit to fishers in other areas of Bonavista Bay or southern Trinity Bay due to a recent increase in landings in these areas – owing to the theory that an increased larval supply may be moving from Eastport to these areas through a combination of prevailing winds and nearshore circulation conditions. However, the relationship between juvenile recruitment and nearshore oceanographic conditions is currently unknown for the area.

In order to better understand the potential effect of other factors, such as prevailing oceanographic conditions, on the local lobster population, further research is required to develop effective protocols for the study of larval drift. Research may also be beneficial to examine the potential effects of v-notching on monitoring results (e.g. male/female size and sex ratio); potential effects of partial (v-notch and berried) and full protection (MPA) on reproductive success); and carrying capacity and density dependence of lobster populations in the MPAs.

Finally, additional analysis of existing data may be undertaken to determine the difference in sex ratios inside and outside the MPA. The results of this analysis would support inferences on mating success in the area.

## SOURCES OF INFORMATION

This Science Advisory Report is from the January 27, 2011 meeting on Eastport Marine Protected Area (MPA) Monitoring Indicators, Protocols and Strategies. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Centre for Science Advice (CSA)  
Newfoundland and Labrador Region  
Fisheries and Oceans Canada  
PO BOX 5667  
St. John's NL A1C 5X1

Telephone: 709-772-3688  
E-Mail: [DFONLCentreforScienceAdvice@dfo-mpo.gc.ca](mailto:DFONLCentreforScienceAdvice@dfo-mpo.gc.ca)  
Internet address: [www.dfo-mpo.gc.ca/csas-sccs/](http://www.dfo-mpo.gc.ca/csas-sccs/)

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